

## PATENT COOPERATION TREATY



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## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 34575PC01	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/DK2004/000225	International filing date (day/month/year) 31.03.2004	Priority date (day/month/year) 31.03.2003
International Patent Classification (IPC) or national classification and IPC F03D1/06, F03D7/04		
Applicant FORSKNINGSCENTER RIS et al		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 4 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  17.09.2004	Date of completion of this report  28.02.2005	
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  de Rooij, M  Telephone No. +31 70 340-2306  	

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**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
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**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-13 as originally filed

**Claims, Numbers**

1-29 filed with telefax on 31.01.2005

**Drawings, Sheets**

1/5-5/5 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	3,5,9-12,17-20,26-29
	No: Claims	1,2,4,6-8,13-16,21-25
Inventive step (IS)	Yes: Claims	17-19
	No: Claims	1-16,20-29
Industrial applicability (IA)	Yes: Claims	1-29
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Reference is made to the following documents:

- D1: US-B1-6 419 187 (BUTER ANDREAS ET AL) 16 July 2002 (2002-07-16)
- D2: US-B1-6 213 433 (BRASE JR LAWRENCE O ET AL) 10 April 2001 (2001-04-10)
- D3: GB-A-2 308 836 (FAGG SIMON) 9 July 1997 (1997-07-09)
- D4: US-A-2 333 482 (ZENO LITTMAN) 2 November 1943 (1943-11-02)

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1 and 24 is not new in the sense of Article 33(2) PCT.

2.1 With respect to the term "substantially" in claim 1, l. 9, it is noted that according to PCT Guidelines 5.34, such a relative, unclear term cannot be used to distinguish the claimed invention from the prior art.

Furthermore, it is noted that document D1 discloses a shape deformable airfoil section comprising an **at least substantially non-deformable part**. (particularly in fig. 5, col. 5, l. 58-67; claim 1 "locally"; col. 3, l. 55-64).

2.2 The document D1 therefore discloses (the references in parentheses applying to this document):

A wind turbine blade (col. 3, l. 42-51) comprising shape deformable airfoil sections wherein the outer surface of each of the shape deformable airfoil sections is substantially continuous in all of its shapes (col. 2, l. 64), and actuator means (claim 2) for providing the shape changes in the shape deformable sections, wherein each shape deformable airfoil section comprises a substantially non-deformable part and one or more deformable parts.

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2.2 Document D1 thereby also discloses (the references in parentheses applying to this document):

A method of controlling the operation conditions of a wind turbine blade according to claim 1, said operation conditions being the air induced noise (col. 6, l. 16-27); said method comprises controlling the shape of the shape deformable airfoil sections, wherein the changes in shape are so that no discontinuities are introduced in the surfaces of the airfoil sections (col. 2, l. 64).

2.3 The subject-matter of claims 1 and 24 is therefore not new.

3. Dependent claims 2-16, 20-23 and 25-29 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, since the additional features are known from D1 or are merely a matter of normal design procedure. See e.g.:

- claim 2: D1, claim 5
- claim 4: D1, col. 3, l. 66
- claims 6 and 7: D1, col. 2, l. 63-66, figures
- claim 8: D1, col. 6, l. 5-9
- claims 13-16: D1, claims
- claims 21 and 22: D1, fig. 5
- claims 23 and 25: D1
- claim 28: definition by result to be achieved
- claims 3, 5, 9-12, 20, 26, 27 and 29: obvious design possibilities, starting from D1 (well known, e.g. from D2-D4)

4. The combinations of features from dependent claims 17-19, is neither known from, nor rendered obvious by the cited prior art.

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**Re Item VIII**

**Certain observations on the international application**

5. In claim 24, "according to any of the preceding claims" has been interpreted as "according to any of the claims 1-22". In claim 23 namely, a wind turbine rather than a wind turbine blade has been defined.

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## AMENDED CLAIMS

1. A wind turbine blade comprising
- 5 one or more shape deformable airfoils sections wherein the outer surface of each of the shape deformable airfoils sections is substantially continuous in all of its shapes, and
- 10 actuator means for providing the shape changes in the shape deformable airfoil sections wherein each shape deformable airfoil section comprises a substantially non-deformable part and one or more deformable parts.
2. A wind turbine blade according to claim 1, wherein the actuator means are(is) active means in the sense that they(it) provide(s) changes in shape by supplying them(it) with energy.
- 15 3. A wind turbine blade according to claim 1, wherein, the outer surface of at least one of the deformable parts is defined by a skin made of a flexible material, e.g. rubber.
4. A wind turbine blade according to claim 3, wherein at least one of the deformable parts
- 20 is a shell construction in which the skin defines the shell.
5. A wind turbine blade according to claim 4, wherein the interior of the shell construction is occupied by a deformable supporting material, such as a foam made of plastic or rubber.
- 25 6. A wind turbine blade according to any of the claims 3-5, wherein the transition between the outer surface of the substantially non-deformable part and the skin of the deformable parts is substantially smooth, such as substantially continuous.
7. A wind turbine blade according to any of the claims 3-6, wherein the non-deformable
- 30 part comprises abutment surfaces on which the skin abuts, the abutment surfaces being shaped so that the transition between the outer surface of the substantially non-deformable part and the skin is substantially smooth, such as substantially continuous.
8. A wind turbine blade according to any of the claims 3-7, wherein the actuator means
- 35 acts(act) on the inner side of the skin.
9. A wind turbine blade according to any of the claims 3-8, wherein the actuator means is(are) a longitudinally extendable device(s), preferably being a hydraulic device, having

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one end connected to the skin and the other end connected to the substantially non-deformable part or a structure connected to the substantially non-deformable part.

10. A wind turbine blade according claim 9, wherein the longitudinally extendable device at  
5 one end is attached in the vicinity of either the upper or lower side of the airfoil.

11. A wind turbine blade according to claim 9 or 10, wherein the longitudinally extendable  
device(s) extend(s) mainly in the cordwise direction and wherein the end being connected  
to said skin is connected to the skin at the lower side of the airfoil and the end being  
10 connected to the substantially non-deformable part of the structure is connected in the  
vicinity of the upper side of the airfoil or vice versa.

12. A wind turbine blade according to any of the claims 9-11, wherein the longitudinally  
extendable device(s) is(are) an extendable piston device.  
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13. A wind turbine blade according to any of the claims 3-7, wherein the skin is attached  
to the substantially non-deformable part and wherein the actuator means is situated within  
the skin.

20 14. A wind turbine blade according to claim 13, wherein the actuator means is(are)  
material composition(s) which elongation(s), shortening(s) and/or bending(s) is(are)  
controllable by applied electrical current(s), e.g. being a smart material.

15 15. A wind turbine blade according to claim 14, wherein the material composition is  
sandwiched or embedded in the skin, preferably in such a manner that no slip between the  
material composition and the material of the skin occurs during deformation of the skin.

30 16. A wind turbine blade according to claim 14 or 15, wherein the material composition is  
applied to the interior surface of the skin, preferably in such a manner that no slip between  
the material composition and the material of the skin occurs during deformation of the  
skin.

35 17. A wind turbine blade according to claim 1, wherein at least one of the shape  
deformable parts is made of flexible material(s), e.g. rubber, and wherein the actuator  
means is(are) an extendable beam(s) extending within the material(s).

18. A wind turbine blade according to claim 17, wherein the at least one deformable part is  
made solely of flexible material(s) and has one or more voids.



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19. A wind turbine blade according to claim 17 or 18, wherein the extendable beam(s) is(are) made from a material composition which elongation(s), shortening(s) and/or bending(s) is(are) controllable by applied electrical current(s), such as made from a smart material.

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20. A wind turbine blade according to claim 1, wherein the actuator means are(is) passive in the sense that they provide(s) changes in shape as a result of movement of the blade, said movement being preferably torsion, bending and/or rotation of the blades.

10 21. A wind turbine blade according to any of the preceding claims, wherein the substantially non-deformable part is a central part of the blade and wherein the one or more deformable parts are the leading edge region and/or the trailing edge region.

22. A wind turbine blade according to any of the claims 1-21, wherein the substantially  
15 non-deformable part is a load carrying part.

23. A wind turbine having one or more wind turbine blades according to any of the claims 1-22.

20 24. A method of controlling the operation condition(s) of a wind turbine blade according to any of the preceding claims, said operation condition(s) being preferably the load on the blade(s), the power produced by the wind turbine, air induced noise, the stability of the wind turbine and/or the like; said method comprises controlling the shape of the shape deformable airfoil sections, wherein the changes in shape are performed so that no  
25 discontinuities are introduced in the surfaces of the airfoils sections.

25. A method according to claim 24, wherein each or some of the shape deformable airfoil sections comprise one or more of the features according to any of the claims 1-23.

30 26. A method according to claim 24 or 25, wherein the wind turbine comprises detecting means for detecting the one or more operation(s) conditions, wherein the detected operation condition(s) is(are) input to a computer system comprising functionality determining shape deformations to be imposed on some or all of the deformable airfoil sections based on said input.

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27. A method according to claim 26, wherein the detecting means comprise(s) means for measuring the blade flow pressure, the rotor position and/or strain gauges, accelerometers or the like provided on one or more components of the wind turbine, said components being typically and preferably the blade(s), the nacelle and/or the tower.

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28. A method according to any of the claims 24-27, wherein a typical time scale for a deformation to be introduced in the deformable airfoil sections, is lower than the time for one rotor rotation, preferably lower than half the time for one rotor rotation, such as lower than one quarter for the time for one rotor rotation, such as lower than the time it takes  
5 for a blade to rotate 10°, such as 15°.

29. A method according to any of the claims 24-28, further comprising the step of setting and/or altering the full span pitch of each blade.

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